We hope you have found the material in this white paper helpful and useful. We at the University of Tennessee are committed to translating our No. 1 position in academic research into information useful for practitioners. We believe the real world of industry is our laboratory. It’s why we have the largest Supply Chain Forum in the academic world, with over 50 sponsoring companies. We are always looking for industry partners to assist us in this journey. Let us know if you are interested in being one of our valued partners.

J. Paul Dittmann, Ph.D.
Executive Director, The Global Supply Chain Institute
The University of Tennessee
jdittman@utk.edu
O: 865-974-9413
C: 865-368-1836
gsci.utk.edu

SOURCES
This white paper is based in part on material from the recent book: Global Supply Chains: Evaluating Regions on an EPIC Framework—Economy, Politics, Infrastructure, and Competence by Mandyam Srinivasan, Theodore Stank, Philippe-Pierre Dornier, and Kenneth Petersen (McGraw-Hill Professional) 2014 with permission from McGraw-Hill Professional. (See a full description of this book at the end of this document.) In addition, new research based on in-depth interviews from ten leading companies conducted in support of this white paper identifies best practices used to manage global supply chains.

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GLOBAl SUPPLY CHAINS

A FINAL NOTE
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GLOBAL SUPPLY CHAINS

THE FOURTH IN THE GAME-CHANGERS SERIES OF UNIVERSITY OF TENNESSEE
SUPPLY CHAIN MANAGEMENT WHITE PAPERS*

FALL 2014

AUTHORS:
TED STANK, PH. D.
MIKE BURNETTE
PAUL DITTMANN, PH.D.

*Past University of Tennessee Supply Chain Management white papers are
listed below and can be downloaded by going to the “Publications” section
at gsci.utk.edu:
• GAME-CHANGING TRENDS IN SUPPLY CHAIN, September 2013
• BENDING THE CHAIN, April 2014
• RISK IN THE GLOBAL SUPPLY CHAIN, June 2014
Executive Summary: Best Practices for Managing Global Supply Chains

Over the last several decades, business has become truly global. Though globalization has benefitted many organizations via the creation of new markets, it also has presented serious new challenges for supply chain executives who often struggle to achieve desired customer service, quality, cash, cost, responsiveness, and innovation standards. The University of Tennessee’s Global Supply Chain Institute (GSCI), in cooperation with sponsor BT Global, has developed the following white paper to capture best practices for supply chain leaders seeking to design and manage their global supply chains.

The paper begins with insights from a recent book authored by a team of faculty from the University of Tennessee and ESSEC School of Management (Paris, France) entitled Global Supply Chains: Evaluating Regions on an An EPIC Framework. The EPIC framework originally introduced in the book provides a methodology and approach that enables firms to better assess different locations for locating global supply chain operations, including sourcing, manufacturing, and distribution. To validate the premises of EPIC, we interviewed 10 companies that we believe possess best-in-class global supply chains in order to glean best practices. These interviews also are described in the white paper.

Global supply chain challenges are not new although the last fifteen years have been particularly dynamic with the emergence of economic opportunity across South and Southeast Asia, as well as in select locations in Eastern Europe, South America, and even Africa. The rapid ascent of developing nations within these regions, including China and India in particular, have held the promise for more than a decade of reaching pockets of intellectual and financial capital from across the world, along with major cost reduction. As a result, many firms had offshored much of their product sourcing and manufacturing to Chinese or other Asian suppliers by the mid-2000s.

This rush to Asia was often driven by cost-cutting strategy. In general, when organizations pursue cost-cutting without giving much thought to associated impacts on customer service, they operate in a cost world, and not a total cost of ownership or TCO world. (By TCO, we mean “full cost accounting,” where all conceivable costs both direct, indirect, and even the cost of lead-time and lost
The adoption of a short-term, cost-cutting mindset inevitably drives firms toward less than optimal decisions and strategies that will lead to poor long-term outcomes. A key question addressed in this white paper is: “Why did so many organizations find that the expected savings from global sourcing initiatives failed to materialize?” An obvious answer is that these organizations simply did not do their homework. They focused on short-term cost reductions without considering all of the hidden costs associated with the TCO of their offshoring decisions and neglected to consider the significant potential negative impacts this approach would yield for supply chain responsiveness.

Our research demonstrates that only a very small percentage of organizations fully consider many of the hard-to-compute supply chain costs that can severely hurt an organization’s competitive advantage. These costs include the cost of lead time, the cost of (in)flexibility, the cost of quality, the cost of lost sales, and of course the costs associated with the added risks that exist within a global environment. Costs such as these give a whole new meaning to the phrase, “Distance matters.” Today, the organizations that pay attention to these costs of globalization are tending to focus more on near-shoring, or perhaps even re-shoring their supply chain operations.

Additionally, though many organizations will acknowledge that they did not conduct a thorough TCO analysis prior to making global network decisions, they are reluctant to acknowledge a more profound problem: They struggle to execute their supply chain adequately in the dynamic global environment. Going global increases cost, complexity, and risk, and managing these three aspects simultaneously can be extremely challenging.

The story of the second decade of the 21st century will be different. As global supply chains proliferate, organizations operating in one country will increasingly depend on organizations headquartered or operating within the boundaries of other countries to either supply material or market their products. Our research suggests that global supply chains across the world will eventually break into a series of demand and supply pods where regional procurement and manufacturing operations will supply the major demand centers of the area, at least for a significant percentage of production requirements.

Supply chain professionals who operate in the global environment need to be armed with a solid global supply chain management strategy. An important tool needed to develop this global supply chain strategy is the EPIC framework from the book mentioned above: *Global Supply Chains: Evaluating Regions on an An EPIC Framework*. We describe the EPIC framework below, and then explain how companies can use it to increase their global competitiveness.
Using the EPIC Framework to Evaluate Global Regions

Global supply chain managers can benefit from a tool that helps them assess their supply chain location decisions, identifying the strengths, weaknesses, opportunities and threats of the different regions in the world. The EPIC framework provides the structure for assessing various regions around the globe for supply chain readiness from Economic (E), Political (P), Infrastructural (I) and Competence (C) perspectives.

The EPIC framework defines and explains these dimensions of the global market environment, in order to assess their potential impacts on the effectiveness of global supply chain management activities, as well as to identify the characteristics of those dimensions in each region of the world. The framework measures and assesses the levels of “maturity” held by a geographic region, with specific respect to its ability to support supply chain activities. The four EPIC dimensions are then assessed using a set of variables associated with each dimension. Each EPIC variable is assessed using a combination of quantitative and qualitative scores based on data drawn from a wide variety of data sources.

Regional assessments for 55 countries are included in the EPIC analysis. The assessments are organized along 10 distinct geographic regions: East Asia, South Asia, Southeast Asia, Australia, Mid-East and North Africa, Sub-Saharan Africa, Western Europe, Central and Eastern Europe, North America, and South America. The assessments utilizing the EPIC framework ranged from D (lowest score) to A. The scores for all 55 countries are listed in the white paper. A summary of the key findings, in the form of narrative themes, follows below.

Summary of Key Themes from the EPIC Assessment

- Supply chains have undergone a series of phase transitions over the ages, from trading, to manufacturing, and on to the current era of global, IT-enabled supply chains. These transitions have been fueled by political and technological innovations.

- These political and technological innovations have resulted in global economic power moving from Asia to Europe near the middle of the 18th century and then to North America following World War II. Recent trends suggest that the balance of economic power is either moving back to Asia or at least being leveled across the Americas, Europe and Asia. Supply chain professionals must have a robust total cost of ownership process as described above to stay ahead of the changes in the dynamic global environment.

- The world is becoming flatter as barriers to free-market capitalism are removed, the use of the Internet becomes more widespread, and there is
an increased flow of goods across borders. However, the extent to which the playing field is being leveled is up for debate. The flattening trend could reverse course. Stranger things have happened.

**Best Practices**

Equipped with the EPIC framework, we talked with 10 leading supply chain companies that have demonstrated best-in-class capability in global supply chain management. These companies came from CPG, chemical, luxury, materials refining, food, supply chain services, and health care industries. In the interviews conducted to identify global supply chain best practices, the benchmark supply chain organizations addressed the need to have strong capability in two important areas:

1. Ability to make high quality supply chain network design decisions (SCND)
2. Systems to manage complex, global supply chains

**SCND - Global Sourcing Analysis and Decision Making**

In making global sourcing decisions, our best in class, companies followed five best practices:

- Supply chain decisions are **strategy driven**.
- These firms strive for **scale**.
- Supply chain organizations have a core competence in **fact based, quantitative analysis**.
- Supply chain decisions are **TCO**- (total cost of ownership) and **NPV**- (net present value) based.
- Supply chain decisions are based on **holistic product designs** appropriate for the global environment.

**Best Practices for Managing a Complex, Global Supply Chain**

In our discussions with the best-in-class supply chains, we also saw five best practices in managing their complex global supply chains. Those five were:

- An effective **global S&OP** process
- A **process to manage complexity**, especially product complexity
- Strong **supplier collaborative partnerships**
- A **talented team** on the ground
- **Clear visibility** throughout their global supply chain and **rapid response capability**
In the white paper we discuss these best practices along with specific examples of successes and failures to illustrate the learning that drove the best practices.

We wanted to make a special note of the last best practice listed above: “clear visibility and rapid response systems.” Managing supply chain risk is an expensive and critical process in global supply chain management. For this best practice we have included a supply chain visibility case study in the white paper.

Visibility is extremely important in any domestic supply chain, but it reaches another level in the global environment. A domestic supply chain with lead times of days or weeks can easily stretch to multiple months when placed in a global environment. Countless events routinely disrupt a supply chain over such an extensive time span, particularly in emerging third world economies. A global supply chain faces disruptions resulting from demand spikes, natural disasters, political unrest, strikes, unexpected regulatory issues, port problems, and terrorism. Tools are available to enhance supply chain visibility. **BT Trace** from BT Global is one example of a leading edge solution.

### Few Global or Multi-Local?

As supply chain leaders, we realize that the best global network decisions are based on business and strategic needs. In essence, there is no one best answer for our work.

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<thead>
<tr>
<th>FEW GLOBAL</th>
<th>MULTIPLE LOCAL</th>
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<tbody>
<tr>
<td>Do you have a low total supply chain cost as % of total Revenue?</td>
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<tr>
<td>Do you have a high level of technical complexity? Do you need high level skills to produce?</td>
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<tr>
<td>Do you have complex technology. Is it proprietary (legally protected)?</td>
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<tr>
<td>Is your sales/volume distributed evenly across the world?</td>
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<td>Is your logistics cost a high % of your total SC (value) chain cost?</td>
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<td>Does your business require a high level of SC responsiveness?</td>
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<tr>
<td>Are your products regionally specific? Does your business require regional specific new product innovation?</td>
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<td>Does your business have a high correlation of customer service defects to lost revenue?</td>
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<td>Is Inventory Management (managing cash to the lowest levels) of high importance to business?</td>
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Introduction: Global Supply Chain

Back to the Future

Perhaps you decided to read this white paper because you have a global supply chain and you urgently need to improve it. You most likely have global suppliers and/or global customers. You know you need to manage this complex network to provide better service to your end customers, but you also must do that with ever-lower costs and inventory levels. Our goal is to provide a series of best practice recommendations based on the EPIC framework from the recent book, *Global Supply Chains—Evaluating Regions on an EPIC Framework* to help you meet these daunting challenges.

Although the term “supply chain” was not commonplace until the late 20th century, global supply chain challenges are not new—they have existed for centuries. The Phoenicians traded actively with Egypt more than 4,500 years ago, establishing the Middle East as one of the first major crossroads of global trade. From 206 BC into the 15th century, the Silk Road played a significant role in the economic development of China, India, Persia and Arabia. Asia was the center of supply chain activity until the Industrial Revolution in England dramatically shifted this to Europe.

The United States emerged on the global scene in the late 1800s, fueled by the completion in 1869 of a continuous railroad line that stretched across the continent from the Atlantic Ocean to the Pacific Ocean. Soon, trains were carrying freight loaded with cargo such as teas, silks, and other handcrafted items from Japan, India, and China. Spices, fruits, cattle, sheep, and minerals were transported across the continental US.

Japan reemerged from the destruction of World War II as a global force in the 1960s. The Japanese automotive industry grew from producing just over half a million vehicles in 1960 to producing more than 11 million vehicles in 1980—a number that exceeded US auto production by more than three million vehicles that same year. Japan would remain the world’s leading auto producer for the next 10 years.
Where it all started: The (Re-)emerging Power of Asia

Although Japan may have led the way, the last 15 years have witnessed a reemergence of economic power across Southern and Southeast Asia, as well as in select locations in Eastern Europe, South America, and even Africa. While outsourcing to China and other Asian countries may be slowing, the growing economic might of the region and its impact on global supply chains will continue to make it a force with which to reckon. The rapid ascent of these developing nations (China and India in particular) in the early part of the 21st century led New York Times columnist Thomas L. Friedman to write his best-selling book, *The World is Flat*. Friedman’s book posits that a series of events including the deregulation of trade, liberalization of foreign direct investment, and the development of the Internet have combined to “flatten” the world, or level the playing field that the industrialized world has enjoyed since the dawn of the industrial age. As a result of these forces, many Western-based manufacturing organizations found that it was possible to outsource activities, essentially splitting up work and sending individual operational pieces to far-flung locations like Bangalore and Beijing. The resulting structure enabled activities to be performed virtually round the clock. Such outsourcing also held the promise of reaching pockets of intellectual capital across the world. By the mid-2000s, many firms had moved virtually all product sourcing and manufacturing to Chinese or other Asian suppliers offshore.

While Friedman’s vision of the world in the 21st century was initially met with widespread support, it also has been subject to controversy and criticism. His critics argue that the world is far from flat, and that differences between countries remain much larger than acknowledged. Organizations that outsourced to emerging markets initially were enthralled by the dramatic reduction in the cost of goods sold (COGS) engendered by this new purchasing arrangement. However, they soon found that the arrangement had a downside. There was a dramatic increase in average finished goods inventory, with an accompanying decrease in inventory turns. For many companies, cycle times from the Chinese manufacturers grew to an average of more than 100 days from order to delivery. Customer metrics such as product availability slipped. Worse, the savings greatly diminished with rising fuel prices, growing production labor rates, and increasing inventory to curb the risk of disruption or order delay. In sum, many companies discovered a number of hidden costs and risks associated with offshoring.

As a result of the changing cost and risk structure, companies began considering other locations as alternatives to Chinese/Asian sourcing. This seems to be leading full circle to a near-shoring trend worldwide. To stay in front of this changing global dynamic, it is important for supply chain professionals to understand the total cost of ownership for various supply chain alternatives.
It’s “All About” the Shifting Total Cost of Ownership (TCO)

In general, when organizations pursue a cost-cutting strategy without giving much thought to enhancing customer service, they operate in a cost world, and not a TCO world. (By TCO, we mean “full cost accounting,” where all conceivable costs both direct, indirect, and even the cost of lead-time and lost sales, are considered.) A short-term, cost cutting mindset inevitably drives firms toward less than optimal decisions and strategies. Why did so many organizations find that the expected savings from offshoring and global sourcing initiatives did not materialize? An obvious answer is that these organizations simply did not do their homework. They focused on short-term cost reductions without considering all hidden costs associated with the total cost of ownership (TCO) for offshoring decisions and the significant negative impact on supply chain responsiveness.

Our research shows that only a very small percentage of organizations consider some of the hard-to-compute costs that can severely hurt an organization’s competitive advantage. These costs include the cost of lead time, the cost of flexibility, the cost of quality, the cost of lost sales, and of course the cost of added risk in a global environment. These costs give a whole new meaning to the phrase, “Distance matters.” Organizations that pay attention to these costs will tend to focus more on near-shoring, or perhaps even reshoring their supply chain operations. (Note: This is discussed in detail in the UT GSCI white paper Bending the Chain, published in April 2014.) With this TCO framework as a backdrop, supply chain professionals can better understand the changing dynamics of the global supply chain environment.

Execution Is More Important Than Cost

While many organizations will acknowledge that they did not conduct a thorough TCO analysis prior to making global network decisions, they are reluctant to accept a more profound problem: They cannot execute their global supply chain adequately in a global environment where the competitive challenges rise exponentially. Going global increases cost, complexity and risk. Managing these three aspects can be extremely challenging. Even if companies have estimated the total supply chain cost (i.e., TCO) fairly well, they may be unable to handle supply chain complexity.

Worse yet, these companies may not realize or be prepared for the regional differences (cultural and otherwise) that exist in the location of the offshore activity. They may not fully understand the rules of this new global playing field or be prepared to manage the governmental rules and regulations of the country where they are planning to conduct such offshore activity. Even those
managing risk in the global supply chain

10

Some Terms

Supply Chain Network Design - (SCND) – The process for analysis and decision making on supply chain network investments. This includes key suppliers, manufacturing, warehouses, and technical centers. SCND includes capacity, SC capabilities, and “how/when” to use 3rd party partners.

Supply Chain(s) - (SC) – The end-to-end, integrated supply chain from the supplier’s supplier to the consumer’s shelf.

Supply Chain Organization – The holistic resources and teams required to deliver products to the consumer with excellence. This includes (but is not limited to) purchasing, manufacturing, engineering, process control, quality, safety/environmental, Innovation program management, warehousing, transportation/distribution, and logistics (materials/production/category/customer planning).

Global Supply Chains Present Risk for Companies

Cost and execution challenges can keep supply chain professionals up at night, but what about risk in the global supply chain? Is near-shoring the solution for mitigating global risk? Part of the answer to this complex question depends on a complete TCO analysis. Additionally, one must consider soft factors such as cultural or regulatory differences. To understand the impact of risk on global supply chains, we have included the following excerpt from the UT white paper, Risk in the Global Supply Chain (February, 2014):

The supply chain arguably faces more risk than other areas of the company due to its global nature and systemic impact on the firm’s financial performance. Risk is a fact of life for any supply chain, whether it’s dealing with quality and safety challenges, supply shortages, legal issues, security problems, regulatory and environmental compliance, weather and natural disasters, or terrorism. There’s always some element of risk.

Companies with global supply chains face additional risks, including, but not limited to: longer lead times, supply disruptions due to global customs, foreign
managing risk in the global supply chain

Introduction: Global Supply Chains

The repercussions of supply chain disruptions to the financial health of a company can be far-reaching and devastating.

regulations and port congestion, political and/or economic instability in a source country, and changes in economics such as exchange rates.

The scope and reach of the supply chain cries out for a formal, documented process to manage risk but without a crisis to motivate action, risk planning often falls to the bottom of the priority list. The low priority for managing risk in companies is puzzling. After all, supply chain risk management is a very popular topic at conferences, and is written about extensively in books and articles. In spite of all of the discussion, we still see the vast majority of companies giving this topic much less attention than it deserves.

This risk apathy is driven by supply chain executives, who often find themselves at the center of the daily storm, striving to balance very demanding operational objectives while satisfying customers, cutting costs, and helping grow revenue. They must deliver results today, while working on capabilities that will make their companies competitive in the future. They operate in the same maelstrom of competing priorities and limited time as their executive peers—but their scope of activities is broader and they have less direct control over all the moving parts. In this environment, risk management receives much less priority than it should.

The repercussions of supply chain disruptions to the financial health of a company can be far-reaching and devastating. A study by Georgia Tech Professor Vinod Singhal emphasizes the negative consequences. The study analyzed more than 800 supply chain disruptions that took place between 1989 and 2000. Firms that experienced major supply chain disruptions saw the following consequences over a three-year period:

- 93% decrease in sales
- 33-40% lower shareholder returns
- 13.5% higher share price volatility
- 107% decline in operating income
- 114% ROA decline

There is a silver lining. While risk cannot be eradicated, it can be identified, assessed, quantified, and mitigated. Once a risk management plan is developed, it can become a competitive advantage because so few firms have one.

What Does All of This Mean for Global Supply Chains?

The preceding discussion is not meant to suggest that the globalization of supply chains, outsourcing, and offshoring are undesirable activities due to their riskiness. Rather, such activities must be considered from a more systematic, big-picture, TCO-based perspective. The objective is to create the optimal supply chain strategy based on business needs and total cost analysis.
In addition, our research supports the notion that global supply chains across the world will break into a series of demand and supply “pods” where regional procurement and manufacturing operations will supply the major demand centers of the area, at least for a significant percentage of production requirements. Clearly some low-cost “commodity” items will continue to be procured from low-labor cost regions across the globe. With a trend towards more regional activity, the question then becomes one of identifying the regional locations for offshoring or outsourcing. Should organizations return to procuring and manufacturing at their domestic locations? If so, is the talent and infrastructure still there? Are the total costs and tax environment competitive? These questions are addressed in the book *Global Supply Chains—Evaluating Regions on an EPIC Framework*, referenced above, and best practices that companies are adapting for supply chain network design (SCND – the process for determining the best supply chain solution for a business; including siting for key suppliers, manufacturing, warehousing, and technical centers) are discussed later in this white paper.

Multi-local is the term currently being used to describe this shift back toward domestic sourcing. Gartner, Inc., is a leading IT research and advisory company that publishes an annual “Supply Chain Top 25” list identifying the leading organizations that excel in global supply chain management and highlighting their best practices. In a recent report, Gartner identified three major trends based on the practices of these top organizations:

1. Improved supply chain risk management and resilience.
2. Supply chain simplification.
3. A shift towards multi-local operations.

The third trend, multi-local operations, relates to how these organizations are reassessing their sourcing and manufacturing network to then rebalance their supply network strategies. More specifically, “they are shifting from a centralized model, where these functions support global markets, to a regionalized approach, where capabilities are placed locally but architected globally.” This multi-local trend supports the position on regional procurement and manufacturing.

The Gartner report identifies this trend toward multi-local locations as being driven by a number of factors: tax and government incentives, wage increases in some developing countries like China, and an ever-increasing demand to be responsive to local markets. With respect to wages, the report notes that manufacturers are shifting capacity based on regional wage and logistics expense differentials even within emerging markets.
The Need for a Global Supply Chain Management Strategy

All of these complex issues cry out for framework to inform global supply chain strategy. A policy of simply reacting to the dynamics of the global environment won’t cut it. Supply chains exist to serve customers. Therefore, the CEO and the executive team face the classic tradeoff of how to balance supply chain costs/inventory with customer service, a trade off that becomes incredibly difficult for a global supply chain. Supply chain managers face significant challenges walking this tight rope. Decisions affecting supply chain management are taken as part of corporate global strategy often without giving due attention to how such decisions can be implemented globally by the supply chain managers.

For many firms, we have found that top-level corporate strategies ignore the problem of managing global logistics or view it as an afterthought, a detail that can be accounted for eventually. However, supply chain issues are usually very significant; they can severely erode profit margins, return on invested capital, and shareholder value.

For some perspective, logistics-driven costs accounted for 9.22 percent of the Gross Domestic Product (GDP) for the US on average, during the years 2000 to 2009, with global supply chain costs incurred by US companies being much higher. Assuming that this percentage is representative of the share of global logistics costs for an enterprise, a five percent error in estimating logistics costs in a $3 billion organization can result in a profit margin erosion of more than
MANAGING RISK IN THE GLOBAL SUPPLY CHAIN

Introduction: Global Supply Chains

Multi-local is the term used to describe a shift from a centralized model to a regionalized approach.

$275 million. That is not small change. If other supply chain costs such as order processing, materials acquisition and inventory, planning, financing, and information management are considered, the potential erosion in profit margin could be much higher.

Issues surrounding global supply chain strategies are often structural in nature, involving decisions on where to source material, locate a manufacturing facility, or open a retail center. For example, a decision to source material from a new location is often accompanied by eliminating material from an existing source. Such decisions cannot be reversed easily if the new offshore location fails to meet expectations. Because of this, some corporate strategies now place greater emphasis on the strategic importance of the global supply chain management process, but much additional progress is needed.

Building an efficient global supply chain, however, poses significant challenges. The manager has to juggle a multitude of often-conflicting objectives, and contend with:

- Increasing consumer expectations on product quality and customer service
- Coordinating global supply chain partners to integrate supply and demand
- Global supply chain disruption risks
- Governmental rules and regulations in disparate countries
- Environmental concerns

While the first three concerns are present in every supply chain, the last two are probably more relevant to global supply chain. Although the US lags behind Western Europe in environmental focus, environmental concerns are gaining momentum rapidly. In a survey by McKinsey on the challenges faced by supply chain managers, environmental concerns were found to pose a fast growing challenge. More than 21 percent of the respondents indicated that environmental concerns were their top challenge, nearly double the percentage from a survey conducted three years earlier.

To develop a global supply chain strategy, we recommend a logical and rigorous process that will take time and resources, but pay off many times over in the long run. In particular, we recommend the nine-step strategy development process found in the book Supply Chain Transformation. This supply chain strategic work requires a framework to assess the capabilities of supply chains throughout the world. This assessment is found in the EPIC research.
A GLOBAL SUPPLY CHAIN FRAMEWORK

Supply chain professionals who operate in the global environment need to be armed with a solid global supply chain management strategy. An important tool needed in developing this global supply chain strategy is the EPIC framework discussed in detail in the book Global Supply Chains: Evaluating Regions on an Epic Framework. We’ll summarize the highlights of that framework in the section below.

EPIC FRAMEWORK to Evaluate Global Regions

Global supply chain managers can benefit from a tool that helps them assess their supply chain strategies, identifying the strengths, weaknesses, opportunities and threats of the different regions in the world. We introduce the EPIC framework in order to provide a structure for assessing various regions around the globe for supply chain readiness from an Economic (E), Political (P), Infrastructural (I) and Competence (C) perspective.

The EPIC framework defines and explains the environmental dimensions that impact the effectiveness of global supply chain management activities—including economic, political, and infrastructural and business competence issues. It identifies the characteristics of these dimensions in each region of the world. The framework measures and assesses the level of maturity of a geographic region with respect to its ability to support supply chain activities. The four dimensions are, in turn, assessed using a set of variables associated with each dimension. Each one of these variables is assessed using a combination of quantitative and qualitative scores based on data drawn from a wide variety of data sources.
Assessing Supply Chain Readiness Across Regions of the Globe

Global supply chain managers can benefit from a methodology that will help them assess their options in supporting global initiatives by identifying the strengths, weaknesses, opportunities and threats inherent in the environment of the different regions in the world—a framework that can help managers make better global supply chain location decisions in both emerging and mature markets. The EPIC framework provides a structure that will help managers assess the readiness of global locations to support supply chain operations.

How the EPIC Framework Works

The EPIC framework assesses the key characteristics of a nation that are critical to managing efficient and effective supply chains. Each of these dimensions is evaluated using a number of variables to arrive at a weighted score for that dimension. In turn, the scores on these dimensions are used to arrive at a weighted score for the country. Each of the EPIC dimensions is described below.

**ECONOMY.** The economy dimension assesses the economic output of the country, its potential for future growth, its ability to attract foreign direct investment, and how well it can generate a steady return on investments made in the country. The variables used to assess the economy dimension are the Gross Domestic Product (GDP) and its growth rate, the population, foreign direct investment (FDI), exchange rate stability, consumer price inflation, and the balance of trade. These variables represent the potential opportunity that exists for organizations wishing to engage in supply chain activity in the country. For instance, the GDP of a country is largely determined by its industrial or service activity, which in turn significantly influences the level of supply chain activities.

**POLITICS.** The politics dimension assesses the political landscape with respect to how well it nurtures supply chain activity. The variables considered in the politics dimension include the ease of doing business, bureaucracy and corruption, the legal and regulatory framework, tariff barriers, the risk of political stability, and intellectual property rights. These variables influence the environment within which supply chains operate. For example, bureaucracy, corruption, stability of the political system, intellectual property rights, and hiring and firing laws significantly impact even the day-to-day operations in a supply chain. In many countries it requires several weeks to receive customs clearance. Similarly, in certain regions transportation can be delayed or disrupted by “informal barriers” along the journey that require unforeseen payment before being allowed passage.
Politics is particularly important in the initial implementation phase of a supply chain project, as it requires managers to have knowledge of the country and ports from which products will be imported, the safest location for warehousing facilities, and so on. Costly delays can result from such issues as licensing, hiring, and environmental compliance. Furthermore, the encoding of cultural and historical norms in the laws of the nation form the legal framework for operations. Managers consistently have mentioned political issues as being among the most difficult when operating in a global setting.

**INFRASTRUCTURE.** The infrastructure dimension tracks variables that strongly influence how supply chains in a country are managed and operated. It represents the potential for leveraging these activities. The variables considered in the infrastructure dimension can be broadly classified into three categories: physical, energy, and telecommunication infrastructures. The physical infrastructure covers the roadways, the railway network, and air and water transportation. The energy infrastructure is responsible for the supply of electricity and fuel. The telecommunications infrastructure is captured by the extent of telephonic and internet-based activity.

Infrastructure has a direct impact on the economy as a whole and especially on supply chain performance. In Sub-Saharan Africa, for example, development efforts are recognizing that more than 50 percent of growth in the region is due to development of transport and telecommunications infrastructure. The tangible characteristics of a nation’s transportation, utilities, and telecommunications infrastructure required to execute supply chain activities greatly affect supply chain performance. An effective ground transportation network greatly facilitates cost-effective movement of product between sourcing, manufacturing, and market areas. Air and seaport facilities are essential to support global trade by efficiently and effectively moving materials into and out of the region. Investment in infrastructure is an element that can be tracked and is a strong predictor of business growth in a nation or region.

Decisions on infrastructure development also require a sound understanding of geography. Roads over tall mountains, across large deserts, and through jungles and marshes generally are not very effective or efficient. In addition, access to stable electricity, water, and telecommunications is essential. For example, many supply chain managers in emerging economies spend significant time and/or money arranging for power generation. Even if a firm does not operate in an emerging market, one or more of its suppliers is likely to operate there. As a result, supply chain managers must be knowledgeable about the conditions in which those suppliers operate so as to ensure top overall supply chain performance.
Competence. The competence dimension assesses the general supply chain skill levels of both the work force and the logistics industry within and out from a country that is a potential part of an organization’s supply chain. Variables include:

- Labor productivity
- Labor relations
- Availability of skilled labor
- Education level of line staff and management
- Availability and competence of the existing logistics service industry
- Speed with which customs and security clearances take place

Competence is another dimension with huge direct impact on supply chain performance. Availability of labor, labor productivity, and the sophistication of supply chain support available through the logistics industry in a nation affect the ability to run high performing supply chains. Mastery of the tangible requirements for supply chain operations is a necessary but not sufficient condition for success.

Supply chain managers must also explore the conditions related to so-called soft issues that culture, history, population, and politics have on supply chain operations. Leading and managing a local workforce is a key success factor in designing and executing supply chain solutions. How people in a region regard work makes a difference. People do not have the same skills, the same references, the same education, or the same hopes from one region to another in the same country, and certainly not across nations or regions. Such issues impact labor force management, attendance, attrition, skill levels, and much more. Performance objectives are not the same by region: in one region level of service may be the requirement for success, in another efficient management of inventory may be key.

The Regional Assessments

Regional assessments excerpted from the EPIC book are shown in Table 1. The table provides the EPIC assessment for 55 countries included in the analysis. It is organized along 10 distinct geographic regions: East Asia, South Asia, Southeast Asia, Australasia, Middle-East and North Africa, Sub-Saharan Africa, Western Europe, Central and East Europe, North America, and South America.
### Table 1: EPIC Assessments

<table>
<thead>
<tr>
<th>Region</th>
<th>Economy</th>
<th>Politics</th>
<th>Infrastructure</th>
<th>Competence</th>
<th>Overall Grade</th>
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## Table 1: EPIC Assessments

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Table 1: EPIC Assessments

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**EPIC Framework and the Supply Chain Network Design (SCND) Model**

These EPIC assessments can be very helpful in completing a first pass at a global strategic design. Now, let’s take it down a level with the introduction of the Supply Chain Network Design (SCND) model. In the table on the next page we introduce a list of practical and more detailed issues that are aligned with the variables in the EPIC framework, and must be considered in a global supply chain network design.
# Table 2: EPIC Variables

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<th>Dimension</th>
<th>Key Variables</th>
<th>Supply Chain Network Design Issues/SCND</th>
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<td>E-commerce vs. retail store</td>
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<td>Decisions on product design</td>
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<td>E-commerce vs. retail store (e.g. courier services)</td>
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Supply chains have undergone a series of phases and transitions over the ages, from trading supply chains to manufacturing supply chains to the current era of global, IT-enabled supply chains. These transitions have been fueled by political and technological innovations that include deregulation of investment and trade laws, interchangeability of components, improved methods of transportation, mechanization, telecommunication, and the Internet.

These political and technological innovations have resulted in the global economic power moving from Asia to Europe beginning around the middle of the 18th century, and on to North America following World War II. However, recent trends suggest that the balance of economic power is either moving back to Asia or at least being leveled across the Americas, Europe, and Asia. Supply chain professionals must have a robust total cost of ownership process as described above to stay ahead of the changes in the dynamic global environment.

The world is becoming flatter as barriers to free-market capitalism are removed, the use of the Internet becomes more widespread, and there is an increased flow of goods across borders. However, the extent to which the playing field is being leveled is open to debate. Questions remain about whether the flattening trend could reverse course. Stranger things have happened.

As global supply chains proliferate, organizations in one country will increasingly depend on organizations from other countries to either supply material or market their products. Organizations should therefore position themselves to take advantage of such co-dependencies to further their competitive position in the marketplace. They must question on which regions of the world they should focus their attentions when developing such collaboration.

Our research supports the notion that global supply chains across the world will break into a series of demand and supply pods where regional procurement and manufacturing operations will supply the major demand centers of the area, at least for a significant percentage of production requirements.

In addition, three predominant themes emerge from the EPIC assessment that relate to key supply chain decision areas covering demand markets, sourcing and manufacturing, and global trade and logistics.
1. DEMAND MARKET TRENDS: Despite the fact that other regions of the world are closing the gap in economic activity, strong consumer markets for finished goods remain in the US and Canada, the European Union (although at a lower level than pre-2009 heights), Japan, South Korea, Taiwan, as well as in the large emerging markets of the BRIC nations (Brazil, Russia, India, and China). In these countries, product volumes, diversity, and short product life cycles are key for consumer goods managers, in particular for managers of Fast Moving Consumer Goods (FMCG). Other nations with rising consumer markets include Mexico, Turkey, Saudi Arabia, Colombia, South Africa, Indonesia, Malaysia, and Thailand. In all of these countries, the speed of development, changing volume requirements, and varying geographies and transportation infrastructure are the most challenging issues.

2. SOURCING AND MANUFACTURING: Significant re-engineering of supply chain networks is currently underway. The top emerging areas of opportunity for sourcing, manufacturing, and logistics to support regional and/or global consumer markets include Vietnam, Malaysia, India, Chile, Colombia, Uruguay, Brazil, Mexico, Costa Rica, Poland, Czech Republic, Slovakia, Nigeria, South Africa, Kenya, Germany, and the southern and western regions of the US. In addition, many opportunities are just beginning to emerge in Africa, largely supported by infrastructure investment from China. Even in certain regions of Africa, where the manufacturing network may not meet requirements for worldwide distribution, factories are capable of efficiently and effectively serving as a source of supply for products delivered within the region.

3. GLOBAL TRADE AND LOGISTICS HUBS: The changes in market, sourcing, and manufacturing locations will predicate changing trade lanes among business nodes. Usual locations for establishing global trade and logistics hubs, as well as minor assembly, packaging and/or redistribution facilities include Hong Kong, Singapore, Shanghai, and Rotterdam. In addition, similar opportunities are emerging in locations such as the UAE (specifically Dubai), Panama, Colombia, Saudi Arabia (thanks to the developing trans-Arabian highway), South Africa, Egypt (assuming political stability returns in the near future), Algeria, and Morocco. Even within regions, trade flows are shifting to highlight new areas of focus for assembly and logistics operations. In Europe, the center of gravity for trade flows is slowly shifting from a western-oriented logistics network to one that is more centrally focused on the continent. In North America, flows are slowly shifting from an east-west or west-east axis to a more south-north access as Mexican ports and manufacturing centers gain in prevalence. The anticipated opening of the new Panama Canal in 2015 also promises to increase trade volumes in Gulf of Mexico and Southeastern US ports, further strengthening that trend.

Best Practices

Equipped with the EPIC framework, we talked with 10 leading supply chain companies that have a best in class capability not only in managing large, complex global supply chains, but also in global supply chain network design (SCND). These companies came from CPG, chemical, luxury, materials refining, food, supply chain services, and health care industries.

In the interviews conducted to identify best practices, the best in class supply chain organizations addressed two important questions:

1. How should one make the network location decisions for warehouses, key suppliers, manufacturing, and technical centers (also known as the SCND process)?
2. As a leader and owner of a complex, global supply chain, how do you best manage it?

Based on these questions, we developed the following two sets of Best Practices:

1. SCND
2. Managing complex, Global Supply chains

SCND - Global Sourcing Analysis and Decision Making

In making global sourcing decisions, our best in class companies followed five best practices:

- Supply chain decisions are **strategy driven**.
- These firms strive for **scale**.
- Supply chain organizations have a core competence in **fact-based, quantitative analysis**.
- Supply chain decisions are **TCO**- (total cost of ownership) and **NPV**- (net present value) based.
- Supply chain decisions are based on **holistic product designs**, appropriate for the global environment.

We discuss each of these five best practices below, and give practical examples for each.
1. STRATEGY DRIVEN

Supply chain sourcing and network decisions need to support the strategy of your business. Clearly, supply chain leaders want to design supply networks that provide a competitive advantage, based on the strategic needs of the business and the competing market/products.

Unfortunately, this is a major challenge for supply chain leaders. The issue is not a lack of desire, but a lack of resources available to supply chain professionals to understand the global market trends. In fact, one general manager states, “I cannot predict the future, especially in the global environment—you build what you think you need now.” Obviously, this is dangerous. As a first step, supply chain leaders must work with the business leaders, marketing, and R&D to document a clear picture of the long-term business plan (goals, strategies, priorities, regional splits, sources of volume, categories, and products). Frequently the supply chain leader must facilitate this process. This is step one and the cornerstone of SCND.

Beyond the long-range business plan, the overall business leadership team needs to provide clear direction in several key areas that will drive the global supply chain strategy. These include:

- **Supply chain risk.** What are your key supply chain risks (natural disaster, supplier/plant failures, governmental/regulatory, security/terrorism, financial/currency, strike/labor, cyber, etc.)? For the critical risks, is the company prepared to provide capital, resources, and expenses to mitigate the risk? This is a key SCND input. It provides the basis to address questions about single sourcing, supplier partnerships, capital requirements, and countries to avoid. Note: The EPIC framework provides the necessary supporting, region/country insight for this analysis.

- **Responsiveness.** Most general managers start with an expectation for 100 percent customer service. However, supply chain professionals need to guide the business regarding the fundamental SCND trade offs involved. If your business requirements dictate very few, global key suppliers and manufacturing plants, you will have a longer supply chain cycle time. This means your inventory will be higher, your responsiveness to ongoing business variation/demand will be lower, and your responsiveness to launching new product initiatives simultaneously around the world could be reduced. It is best when these trade offs are clearly understood and aligned multi-functionally.

- **New product innovation.** The investment in the supply chain network creates by its very nature parameters for R&D to develop new products. To launch a new product within limited capital and expense budgets, R&D will need to largely utilize existing equipment, processes, suppliers, and materials. To...
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Best Practices

launch “new to the world,” disruptive product innovation (requiring new supply chains), the incremental revenue (market share) needs to be sufficient to create a strong return on the investment. Therefore, the supply chain leader and the R&D leader need to be closely aligned. The technical community (supply chain and R&D leaders) should go to the business leaders with one voice on supply chain capability, product design parameters, and the capacity needed for multi-year new product initiative pipeline.

Examples:

- A large, global company producing beauty care products has a manufacturing design for a plant in North Carolina and in South Africa. The global revenue is primarily in North America (NA), Western Europe (WE) and South Africa. This supply chain network design was based upon the South African plant supplying Western Europe (WE) and South Africa with global products. Unfortunately, the demand in the South African market for these global products was insufficient to meet local business goals. The local South African GM had local profit responsibility. Therefore, the South African plant utilized the majority of its capacity for local products. That required North Carolina to source the product for WE. Due to its high cost structure, this negatively impacted WE business. This global plant network design clearly was not strategic or business driven. This issue is currently being solved through acquisition of WE production facilities.

- A large, global CPG company making detergent products struggled with predicting product design and product forms in various parts of the world. The lack of clarity on future product forms and the long lead-time to react created significant losses resulting from in investment in powder laundry detergents, then investments in liquid laundry detergents, and now investments in laundry “pods.” Clearly the supply chain failed to provide acceptable service to customers in this environment. This is a strong example of why general managers must define the future and synchronize capacity investments and global supply chain capabilities with new product innovation.

- A global chemicals company requires its procurement managers to submit at least two business improvement proposals per year (in the corporate/marketing format). This expectation is included formally in the manager’s work plan and bonus assessment. The supply chain leader wants a strong culture of strategic/business-focused supply chain procurement managers.

- A large, global pharmaceutical company struggled with manufacturing investments. Based on business leadership direction the supply chain built two manufacturing plants (well over $100 million in capital) to

Strategy

and business need assessment is the cornerstone of SCND.
produce a new drug that ultimately was not approved for consumer safety and a new drug that was non-competitive in the market due to consumers’ issues with application. These plant investment decisions cost the company tens of millions of dollars.

- A large, global chemical company is now requiring that all multi-functional business teams (making profit/loss decisions) have two important members from the supply chain organization: Purchasing and Logistics. This ensures that the business decisions incorporate all the key business components (including supply chain implications).

2. SCALE

Arguably, the single biggest benefit of achieving a quality supply chain network design (SCND) is the increased understanding that leaders gain about the supply chains they manage. When that happens, major benefits in global scale can occur. In fact, the “gem” of SCND is when you find scale that can be leveraged to lower cost/cash, higher quality, shorter supply chain time, and improved customer service (a win across the board). This scale could be within your global supply chain, within your company (across other categories), within global industry (e.g. partnerships with suppliers, 3PL’s, competitors), or in other industries having similar equipment, processes, systems, and/or technology.

Examples:

- A large, global consumer products company had significant growth in Central/Eastern Europe. Unfortunately two of the business units in this large company failed to work together. One business unit built a new, state of the art plant in Romania and the other independently built a new, equally impressive, plant in Poland. This is a classic example of not utilizing the scale within the company. Both sites have had successful “start ups” and early success, but both suffer from lost cost opportunities by having excess capacity. A corporate decision for one plant in Central/Eastern Europe would have saved precious supply chain resources.

- A large, global chemical company is driving scale through its acquisition process. Historically, the company would integrate the new acquisitions IT, management, key suppliers, and cultural systems based on the perceived value of the project (priority setting). This led to a series of acquisitions not meeting published financial goals. Today, as a part of the acquisition financial and implementation plan, the company immediately transitions the operations to its SAP IT systems, retains managers with technical mastery (separating other managers that cannot quickly recreate the company...
Arguably, the single biggest benefit of achieving a quality supply chain network design (SCND) is the increased understanding that leaders gain about the supply chains they manage.

Managing Risk in the Global Supply Chain

Finally, a large, global CPG company designs its Asia manufacturing site for multiple category products. In "western countries" the plants are designed by category to provide organizational focus to deliver the business goals. In Asia, the major regional challenges include talent retention (including recruiting/development) and sufficient scale to impact governmental/regulatory support. The larger Asia sites help address these challenges.

3. Analysis Mastery

Many of the examples included in this best practice section highlight failures in SCND that resulted from incomplete assessments of total cost of ownership, lack of scale, and product design. Inadequate SCND was caused by the absence of people and resources to complete a high quality analysis. We have found that many companies initially believe that if you team a smart, talented manager with strong financial support and open access to the supply chain senior executive, you will complete high quality SCND analysis. These companies have learned the hard way that the global supply chain landscape is extremely complex. The EPIC framework provides insight into the complexity of this analysis. The world is changing so fast that the EPIC analysis is a continuous process.

We found that the best in class supply chains:

- Have a dedicated business/SCND analytics department, supply chain network design masters (experts) that maintain the analytical technology, or external partners to lead the analysis. They have data systems and analytical tools designed for accuracy and useful information. The masters have strong connections with access to the latest and most accurate tax structures, duties, customs, transportation costs, and more.

- Start the SCND work with a detailed mapping of the "end to end" supply chain (current and proposed). This step provides two important outcomes. First, it provides a visual training for leadership and the analysis team on global supply chain. Secondly, in our new world of complex, global supply chains, detailed mapping ensures that the right questions are addressed in the analysis.

- Spend at least 15 percent of the analysis time on helping leadership define the problem, which is rarely clear in the initial request. They spend approximately 35 percent of the time completing the analysis (using the tools and
systems that masters can maintain) and roughly 50 percent of the time on sensitivity analysis. Sensitivity analysis is critical. It includes:

- What if analysis (impact of key risks including competitive reaction, etc.)
- Net present value range diagrams (some companies call these “tornado diagrams”) that show the NPV range for different volumes, capital spending, energy prices, etc. (See section below on NPV.)

4. TCO/NPV BASED

In the introduction, the need for a total cost of ownership (TCO) analysis and a net present value analysis (NPV) on all key decisions is discussed extensively. This is clearly an area that has broad alignment and organization support. All the benchmark companies we studied use NPV as the primary measure to compare options in the SCND analysis. This ensures that the best overall value and long term decisions are being made. None of the benchmark companies were having issues with this element of the analysis.

In addition, all the benchmark companies are using a variation of TCO in the SCND analysis. The challenge is in the execution of TCO analysis. Assessing all elements of cost for the complex global supply chain has been difficult. It also has been extremely difficult to determine the true cost of key supply metrics including time, responsiveness, supply chain risk, quality, and inventory. The recent “reshoring” trend and a more balanced strategy/business-driven network design largely corrected many incomplete, initial SCND and TCO analyses. Unfortunately, most of these companies have examples of poor decisions when the total cost analysis was incomplete.
Examples:

- A large, global CPG company completed an analysis to shift production of a body wash product to Mexico. This decision was made at a time when there was heavy discussion in the company regarding leveraging NAFTA and utilizing countries with significant wage rate advantages. The analysis was largely based on manufacturing cost alone. After a decade, the company determined that this initial analysis was flawed. Body wash (large, heavy bottles) has a large transportation cost/unit and a large overall supply chain cost as percentage of total revenue. It requires a responsive supply chain to handle the significant level of customer promotions, and it is sensitive to a high level of inventory. (Note: These types of supply chain/product attributes and how they impact SCND are discussed below in the white paper summary). When the company completed a second SCND, it appropriately moved the body wash business back to a US plant. This enormous cost could have been avoided if a proper TCO analysis had been done in the beginning.

- A high end, global, “luxury product” company utilizes a few global manufacturing and warehousing sites. (See summary below for SCND on product with a very low supply chain cost as percentage of revenue and low/manual technology). The supply chain focused on locating the few, global sites in low wage rate countries in Asia to further improve margins. Initially the manufacturing sites were located in China. As the company learned more about the increasing Chinese wage rate trends and understood Chinese custom/duty cost, the sites have been moved to more cost effective locations in South East Asia, such as Vietnam.

- A large household product company completed a SCND on a new product that included a device, a fabric, and a liquid cleaner. The cost analysis focused on each component in isolation. The accepted practice was to source simple devices from Asia (low wage markets), which was done. They sourced the fabric component from a single global manufacturing site in Germany and the liquid product from the US. The final supply chain network design included a multi-nation global supply network (China, Germany and the US). This proved to be a significant business problem as the “lead” market chosen was the US. This product required quick response time (customer and new product driven) and low levels of inventory (new product innovation). The supply chain was long and slow and had to be redesigned.

*All of the benchmark companies use net present value (NPV) analysis as the primary measure to compare options.*
5. HOLISTIC PRODUCT DESIGN

The benchmark companies we interviewed have frequently learned and developed their global product designs the hard way—through mistakes. In the supply chain introduction, we discussed the learning associated with inaccurate total cost analysis (not appropriately valuing supply chain time and responsiveness).

A second opportunity is in holistic product design. Businesses under extreme Wall Street pressure to grow profit and revenue now have made relatively quick decisions to expand current products globally. These decisions create massive supply chain projects, significant resources, and large capital investments. Supply chain leaders must drive the business and R&D leaders to do the homework on whether consumers will embrace these global products and deliver the early forecasts/global expansion goals.
The major challenges have been entering developing countries where consumers have significantly less disposable income. Typically, lower cost, good quality variations of the global (western world-based designs) are required to win with these consumers. This enables the supply chain to use the same global platform (standard, materials, equipment, processes) but in a way that delivers products affordable to their new consumers. This same principle of “over design” applies broadly to all new products. R&D and Marketing must determine what product attributes the consumer is willing to pay for and which ones they will not (avoiding expensive supply chain design rework).

**Examples:**

- A global consumer products company had significant growth in Central/global consumer product company launched a new product. The marketing department was convinced that the carton color was vital for the new product’s success. The chosen shade of red was only available from an African supplier (Ghana) at a premium cost that required additional inventory investments and longer supply chain cycle time. After the product was launched the business determined that the new product’s critical consumer attributes were price, product performance, and availability on shelf. The unique African dye cost the company millions of dollars in wasted global supply chain cost that could have been spent on the three consumer driven needs or utilized for profit.

- A global, personal care products company had technical mastery of filling shampoo, hair conditioner, and skin care products in plastic bottles. When they chose to enter the massive India market, they launched with the products they knew best. Quickly the company realized that the India market has two components. One market that is largely similar to western habits (large cities, large retailers) and a much bigger market with different consumer habits in the rural areas of India. They quickly developed a second package that fit into the rural outlets (small carts, small product “huts”). The company decided to reapply its individual sachets packets (designed for sampling in western markets). The India rural consumer utilized these single (or few) use product forms to match their needs. After launching the “sampling” sachets, the company determined they could not compete on price with the local competitors. Finally, the company studied the market, competitors, and consumers to design low cost sachets that met the needs. This iterative process (in market) to define the consumer needs created significant rework of the Indian supply chain.
Best Practices for Managing a Complex, Global Supply Chain

In our discussions with the best in class supply chains, we also saw five best practices in managing their complex global supply chains. Those five were:

- An effective global S&OP process
- A process to manage complexity, especially product complexity
- Strong supplier collaborative partnerships
- A talented team on the ground
- Clear visibility throughout their global supply chain and rapid response capability

We discuss each of these five best practice areas below and give practical examples for each.

1. GLOBAL S&OP

S&OP (or Integrated Business Planning) has been discussed in supply chain journals for decades. Many companies have an S&OP system and they are working on improving their system to create a single number, integrated business plan that 100 percent of the organization is utilizing (marketing, sales, finance, and the supply chain) each month. Global S&OP is included in his section primarily due to the difficult nature of a truly global decision.

The same factors are driving exponential growth in supply chain complexity and making our partners’ (marketing, sales, finance, R&D) work more complex. Frequently profit centers in global companies are managed by country or region. This is driven primarily by:

- Better short term results with profit managers close to their consumers
- Government laws, culture, and local financial practices that make local ownership more efficient

This creates a challenge for global supply chain leaders, however. As they work to manage the new world environment, they develop strategies for global suppliers, global manufacturing and warehousing, and sharing of assets between regions. The need for global decision-making (S&OP) increases. We need leaders who can make decisions on allocation of limited finished product and materials. (Should the product go to the highest margin regions? Should it go to regions with current highest marketing spending? Or should it flow to regions launching new products?)

This issue is compounded by the practice of having the local corporate officer
own the local supply chain assets. Is it a conflict of interest for local general managers to decide their country is the first priority during a shortage, or that investments in local plants will be financially allocated to all other regions when the product is exported? Best in class companies clearly define accountability for critical decisions. For each business category, there is visible accountability for the global decision authority.

Examples:

- A large CPG company launched specially-designed products to improve the application of its liquid/cream products. These unique products were single sourced from Asia since they were low cost and very sensitive to wage rates. The North American market was the highest volume, highest profit region globally. By default, the Chinese general manager was the global decision maker. He owned the profit and the supply chain assets were in his region. During a period of tight supply, he decided to allocate available product to the Chinese market. The supply chain leaders had to work this issue through multiple layers of the company to find a person who could make a “shareholder” based decision. This created much churn, confusion, and wasted resources.

- A large, global beauty products company was completing a major aerosol manufacturing sourcing change from the US to Africa. This was a global decision. The local leadership in Africa teamed with R&D to decide on significant new product changes (formula, package) during the transition. The logic was that it would be easier for R&D and less costly for the local market. This proved to be a major business disruption as the project initially failed, crippled by its huge complexity. It created massive customer service outages (lost revenue). The supply chain leaders knew this was too high a risk but were unable to find a global decision maker willing to assess the total, corporate risk.

- A large, global food company manages complex, global supply chains involving development of crop investments. Two of their high profit spices (vanilla and cinnamon) have significant looming capacity shortages. The crop planting investment requires a 15-year lead time (harvest when plants grow to maturity). This 15-year forecast horizon has changed the companies S&OP processes and required new data systems.

- A global education company supplies products to enable learning. In the last decade, these products frequently use the latest IT technology. This is a new area for the company. Product obsolescence (due to the frequency of technology changes) is now a huge factor in profitability. Therefore the business’ global S&OP process has been renewed to ensure stronger alignment on “single number” supply plans.

We need leaders who make good decisions on properly allocating limited product/materials to the right global regions.
2. PROCESS TO MANAGE COMPLEXITY

We found that leading companies are forming, or have programs to handle the exponentially increasing levels of supply chain complexity driven by longer, global supply chains, increasing government/regulatory laws/guidelines, acquisitions, increasing levels of new product initiatives, and complex high-SKU product designs. Most of the best processes to manage complexity center around four strategic action plans:

1. Standardization of equipment, processes, services, products, and systems
2. Simplification of suppliers, materials, specifications
3. Creation of scale by leveraging the company’s scale, 3PL provider scale (industry), supplier scale (partnerships), or corporate joint ventures
4. Implementation of an IT-enabled solution (The days of complex, global supply chains solving the current challenges without high quality, real-time, integrated information systems has been over for some time.)

Platform management is the methodology led by the technical community (supply chain and R&D) to systemically manage much of this global complexity. It was developed in high capital industries (auto, airline, and heavy equipment) and focuses on driving out non-value added cost by leveraging robust process control, standardization, simplification, and early multi-functional technical community involvement in investments.

Examples:

- A large, global food company is growing through acquisition. This is exponentially driving complexity. In addition, the firm faces high global transportation costs and the absolute requirement to maintain product freshness. The appropriate SNCD would invest in many local plants, key suppliers, and warehouses but that creates enormous supply chain complexity. For example, the company has more than 4000 global suppliers, over 700 product specifications for one product category in Europe alone, and greater than 140 plants (more than 30 in Europe). To manage that amount of complexity, the company and its supply chain leaders have deployed an aggressive scale strategy. This strategy involves creating scale by stretching equipment/product/services standardization goals, setting material/supplier harmonization goals, and focusing on manufacturing/warehouse productivity by rationalizing and improving the capacity of assets. In effect, the firm used platform management concepts and tools to drive the scale. This created a step change in cost/cash, quality, new product innovation speed, and customer service by creating scale enhanced by the elimination of complexity that their consumers do not value.
A large, global pharmaceuticals company renewed its product life cycle management (PLCM) system. Several key prescription drugs are moving out of patent protection. This transition creates significant challenges on managing the “end of life” process. Historically, this event has caused major gaps in the revenue/profit progress within the company. The pharmaceutical company is learning from the high capital/high technology business that created PLCM methodology. The “end of life” process focuses on how to use these products in the most productive manner and how to make the right pre-transition planning to optimize profits if the product cannot be re-used.

3. SUPPLIER PARTNERSHIPS (MATERIALS, EQUIPMENT)

A proven approach to supply chain complexity is the creation of supplier partnerships with strategic suppliers. The benchmark supply chains are expanding these partnerships as supply chains become even more complex. We have found that the focus is on the following areas:

- Creating partnerships with a larger set of strategic suppliers (increasing the number of partners)
- Expanding the partners beyond strategic material suppliers to equipment suppliers, 3PLs, service providers, etc.
- Starting to expand the concept to industry partners (driving out broader levels of waste and inefficiency)
- Expanding the focus to communities and sustainability

Examples:

- A large, global food company is creating supplier partnerships with local farmers and growers. The partnerships include company investment in local schools and community facilities. This is a broader definition of partnership but creates value through stronger teamwork and trust.

- A large, global company supplying personal care products is using its strategic material supplier partners to start developing new chemicals and packaging materials. This has caused significant cultural changes in the company (especially R&D), but has enabled the suppliers with the technical mastery to actively participate in new product improvements.

- A large, global food company revitalized material supplier partnerships with their equipment vendors. As the supply chain has implemented platform management, the manufacturing equipment/processes are globally standard. This enables significant capital reductions through partnerships with equipment suppliers. Blanket equipment orders can now be developed, allowing the equipment suppliers to level the workload and drive productivity and cost improvement.
The global supply chain organization in one leading company is initiating discussions on an industry-wide basis. Can the company partner with its competitors to form industry standard secondary packaging? The idea is that secondary packaging is a “non-value added” cost from a consumer point of view. The most efficient solution is an industry standard for all similar products to eliminate warehouse, transportation, and customer logistics costs due to variation in design. This is a stretching goal and has significant challenges to its implementation, but it is a great example of how benchmark supply chain organizations are looking to create a new level of supply chain partners.

4. TALENTED, “ON THE GROUND” TEAM

In the beginning, benchmark supply chains viewed global expansion as a test. Therefore supply chain activities in these new regions were frequently managed with corporate resources and contractors in the regions. This approach caused significant problems (slow responsiveness, high inventory, and limited capability with local regulatory agencies). Today, the supply chain organizations in our benchmark companies use the following principles:

- Locally hire an “on the ground” team to manage the business
- Establish local budgets with a higher percent of training and development funding to support the new organization
- Staff with a sufficient level of “ex-patriot” (expat) managers to provide support for the new team
- Institute a high level of coaching for new employees
- Establish a high standard for corporate cultural expectations (one global culture)
- Create a flexible pay system based on local practices to ensure retention of valued employees
- Assign additional corporate resources/coaches assigned to ensure the success of the new “on the ground” teams
- Co-locate with local marketing and sales offices when possible to drive teamwork on solving local business challenges

Examples:

- A global materials (light weight metals) supplier struggled with quality variation, transportation delays, product accounting, and confidentiality agreements in China. Managing this from a Western country proved ineffective. The company invested in an “on the ground” Chinese team. This has paid strong dividends as the quality, cost, and competitive results have significantly improved.
A global supply chain exemplifies a strong “on the ground” team in the Ukraine. Recent political issues have caused significant problems in the region. The safety of employees, suppliers, operations, and transportation has been a major issue. Additionally, the government has “tightened” procedures to manage the crisis. The Ukraine business has met critical goals because it has a strong “on the ground” team. The team has found creative ways to help with safety, security, and governmental regulations. Some competitors without these local teams were forced to temporarily stop business during the crisis.

5. RAPID RESPONSE (SUPPLY CHAIN VISIBILITY)

Our 5th best practice in “managing complex, global supply chains” is rapid response systems. Managing supply chain risk is an expensive and critical process in global supply chain management. For this best practice we have included the following supply chain visibility case study.

Rapid response is a popular and important concept in the supply chain community today. And clearly, rapid response is possible only when there is clear visibility across the global supply chain. Global natural disasters in Chile, Southeast Asia, and Japan, combined with political unrest in the Ukraine and the Middle East, have motivated supply chain professionals to review their risk mitigation plans. When managing a more complex global supply chain, this becomes a bigger challenge. A key issue is the time it takes to get back in business or working an alternate option to stay in business after a significant event. Therefore, we have included below a more detailed discussion of rapid response and supply chain visibility.

Everyone who plays the famous Beer Game supply chain simulation discovers one immutable truth: Supply chain performance breakthroughs result from creating visibility across the supply chain from suppliers to customers. Without this end-to-end visibility, a firm flies blind, trusting intuition and luck to save the day.

Visibility is extremely important in any domestic supply chain, but it reaches another level in the global environment. A domestic supply chain with lead times of days or weeks can easily stretch to multiple months when placed in a global environment. Countless events routinely disrupt a supply chain over such an extensive time span, particularly in emerging third world economies. A global supply chain faces disruptions resulting from demand spikes, natural disasters, political unrest, strikes, unexpected regulatory issues, port problems, and terrorism.

Tools are available to enhance supply chain visibility. BT Trace from BT Global is one example of a leading edge solution. The critical aspects of global supply chain visibility are discussed below.

Supply chain performance breakthroughs result from creating visibility across the supply chain from suppliers to customers.
It All Starts with the Customer

Supply chain visibility is a critical need for most companies. It requires not a quick fix but instead a major strategy and an implementation plan that could span years. The supply chain visibility strategy should start with a survey of customer needs. Most likely, customers will indicate that they need to know up-to-date and accurate information on the status of their orders, and especially information on the physical location in a global network.

That's not all. They also need to know how to better collaborate with their suppliers, which implies open sharing of data—lots of data. Many firms also need traceability on the outbound flow of goods, and this is especially true for companies who might have to contend with a recall. Examples include food/beverage companies due to contamination, pharmaceutical companies due to drug safety issues, and appliance companies due to product safety hazards. A typical customer needs information such as an accurate order status, the data to effectively collaborate with their suppliers, and traceability, all of which should be incorporated in a supply chain visibility strategy.

Visibility Means Managing Big Data

Firms must manage a massive amount of data to achieve global supply chain visibility. Data from many disparate sources must be captured and translated into a common format, using complex connectors which route various sources of data through a complex network. Harnessing “Big Data” can create significant value by driving profitability, enhancing productivity, and increasing competitiveness.

The challenge is daunting. Firms must efficiently collect, access, share, store, and interpret this data, then turn it into actionable intelligence. Equally or more important is the need to manage the data securely to avoid outside breaches by hackers. One trend that arguably helps with this challenge is the increasing access to data and software via a cloud-based system, avoiding the “up front” capital investment, which can be critical for start-ups in emerging economies.

Visibility of What?

In a global supply chain visibility strategy, firms need to be capable of tracking and tracing more than orders. They also need to monitor inventory by location, transportation assets, and even goods within warehouse operations. This visibility needs to extend upstream to the first and second tier suppliers as well as downstream to customers. As noted, this requires managing large amounts of data from different sources in a secure environment.

Visibility extends to both structured data sources (e.g. ERP systems) and to unstructured data sources such as news feeds, weather information, social media, and more. One company tracks weather data, especially extreme weather events, to identify potential disruptions to its supply chain. The predicted path
Visibility of Visibility

It is not enough to have accurate, timely data. The data need to be displayed in a way that’s easy to access and easy to understand. For example a manufacturer could construct a “control tower” with multiple large monitors that would not only display data, but also have the capability to be queried. Users could easily interrogate the data with specific questions. Pictured below is another example, a control tower from a BT visibility solution, BT Global Trace:

Firms need to see and interrogate the data, and they also need to recognize quickly any out-of-standard situations (exceptions) to enable timely corrective action via alerts sent to PCs, mobile phones, and/or tablets. Corporate resources have limited capacity, and can only deal with the exceptions embedded in the maelstrom of data flooding the system. For example, a specific container may be stalled in the port at Hong Kong for longer than normal. This situation calls for an alert to be triggered and quick action to be taken. Firms involved in global commerce need to develop such a supply chain event management (SCME) capability.

With SCME, a company can monitor, track, and correlate all supply chain events against relevant expected milestones within a business process. The goal of SCEM is to keep all users in the supply chain–from materials suppliers and buyers to warehouse managers and product carriers–informed about activity across the supply chain. As SCME monitors activity in real-time, it can sense problems and respond with alerts, as well as send notifications to appropriate users and partners. (Oracle, SAP, Manhattan, BT, and others have SCME solutions.)
**Control Towers**

“Control Tower” is an increasingly used term to describe an information system that allows a company to monitor and manage its orders and supply chain assets. The challenge is to create an information hub that can capture data from widely varying sources. Generally firms use a third party to set up a control tower. Control towers are far from ubiquitous. In a *DC Velocity* survey, only 12 percent of respondents said they were operating a control tower. One of the most important reasons for a control tower is to better manage the supply base during a disruption such as a weather or terrorist event.

Nearly every firm needs a strategy to create world-class supply chain visibility capability. The payback is simply too great to ignore or leave to ad hoc, uncoordinated actions. The global environment is changing rapidly. As ante to stay in the game, firms need an information system that can handle big data in a secure, efficient manner, generate real time alerts, and display query-able data in a clear user-friendly format.
Global Supply Chains: Evaluating Regions on an EPIC Framework—Economy, Politics, Infrastructure, and Competence is the outcome of a unique partnership between four coauthors who grew up in different parts of the world: the United States, France, and India. The goal of this book is to provide information about supply chains in each region in the world, identifying their unique characteristics to help the decision maker arrive at more informed decisions. Managers of global supply chains can use the framework developed in this book to help them assess their supply chain strategies, identifying the strengths, weaknesses, opportunities, and threats of the different regions in the world.

Most managers do not have the luxury of spending time “in country” to learn the nuances of global supply chain issues prior to making decisions. Having a handy reference to information critical to good global supply chain decision making can significantly help these executives manage supply chains in both emerging and mature markets. It is the pursuit of such knowledge that has driven the authors of this book to develop the EPIC framework—a structure to assess countries around the globe on their supply chain readiness from four different perspectives. The four different perspectives are economy (E), politics (P), infrastructure (I), and competence (C).

The EPIC framework is used in the book to assess 55 countries in 10 geographic regions around the globe. The framework is intended to help organizations that wish to invest in or manage supply chains in these regions or countries. Each of these dimensions evaluates a number of variables to arrive at a weighted score for that dimension. In turn, the scores on these dimensions are used to arrive at a weighted score for the country.

The research conducted for this book reveals that key variables in the macro-environment can help managers better understand the framework for decision-making and reduce uncertainty. Knowledge of the levels of these variables enables supply chain managers to choose the locations for value-added supply chain operations for their enterprise, including transportation hubs and modes for raw materials, location of parts and subcomponent suppliers, finished goods manufacturing and assembly locations, and transportation and distribution hubs for finished goods. In particular, the research results reveal interesting combinations of sourcing, manufacturing, and logistics options for different regional consumer markets.


Summary

Global supply chains have undergone a series of phase transitions over the ages, from trading supply chains to manufacturing supply chains to the current era of the global, IT-enabled supply chains. These transitions have been fueled by technological innovations. These innovations have resulted in the global economic power moving from Asia to Europe (middle of the 18th century) to North America in the latter half of the 20th century. Recent trends suggest that the balance of economic power is either moving back to Asia or at least being leveled across the Americas, Europe and Asia. Supply chain professionals must have robust best practices to stay ahead of the changes in the dynamic global environment as barriers to free-market capitalism are removed.

In this decade, businesses compete on a global platform. There are no geographical boundaries in the search for revenue and profit. As supply chain leaders, we realize that the best global network decisions are based on the business and strategic needs. In essence, there is no one best answer for our work. The EPIC framework, along with the best practices for supply chain network design (SCND) as well as the best practices for managing complex supply chains discussed in this whitepaper, provide valuable tools for supply chain leaders to design and manage a winning global supply chain.

We have included a simple chart to provide macro direction for global supply chain network design. Based on our research and interviews with our benchmark supply chain companies, this chart is a place to start as you enter the complex world of global supply chain design.
### Global Supply Chain Network Design (SCND)

Should you have very few global or multiple local suppliers/plants/warehouses?

<table>
<thead>
<tr>
<th>FEW/GLOBAL</th>
<th>MULTIPLE/LOCAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have a low total supply chain cost as % of total Revenue?</td>
<td>Is your sales/volume distributed evenly across the world?</td>
</tr>
<tr>
<td>Do you have a high level of technical complexity? Do you need high level skills to produce?</td>
<td>Is your logistics cost a high % of your total SC (value) chain cost?</td>
</tr>
<tr>
<td>Do you have complex technology. Is it proprietary (legally protected)?</td>
<td>Does your business require a high level of SC responsiveness?</td>
</tr>
<tr>
<td>Are your products regionally specific? Does your business require regional specific new product innovation?</td>
<td></td>
</tr>
<tr>
<td>Does your business have a high correlation of customer service defects to lost revenue?</td>
<td></td>
</tr>
<tr>
<td>Is Inventory Management (managing cash to the lowest levels) of high importance to business?</td>
<td></td>
</tr>
</tbody>
</table>
Global Our research shows that there is no one best answer to the complex analysis and decision making processes required to develop winning supply chains.

Are your supply chains designed to win? Are you sure?

Take the SCND test on the next page. Let this tool provide insight into your current supply chain. Perhaps your supply chain was initially providing your business a competitive advantage. Your business and the world are changing at a rapid pace. Has your SCND kept up with the pace of change?

Send copies of this simple, self-test to members of your leadership team, supply chain analysis leaders, and your multi-functional business partners. This can be a great supply chain design team building exercise.

**Note:** This diagnostic is “directional.”

A. If you scored in the 15 to 30 range—a detailed TCO should be performed.

B. For some supply chains, one of the nine SCND attributes may be so important that it could drive the design independently.
**Few Global or Multiple Local**

Answer the questions on a 0, 1, 2, 3, 4, 5 scale. Reference descriptions of 0 and 5 scores in the chart. Apply the questions based on your strategic/business needs and supply chain design/capability.

<table>
<thead>
<tr>
<th>What is a “0”? “Few Global” Attribute</th>
<th>Questions</th>
<th>Score (0-5)</th>
<th>What is a “5”? “Multiple Local” Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue and volume primarily comes from one region/country (&gt;60%)</td>
<td>1. Is your revenue/volume distributed evenly across the world?</td>
<td></td>
<td>Revenue and volume is distributed across multiple regions (i.e., Asia, NA, SA, Europe, Africa) and no more than 35% from one region.</td>
</tr>
<tr>
<td>Low level of responsiveness required—“drumbeat” processes for new product initiatives, relative flat or predictable demand patterns</td>
<td>2. Does your business require a high level of responsiveness?</td>
<td></td>
<td>High level of responsiveness required. Demand is unpredictable (i.e., urgent customer requests for special shipments or large promotion quantities, rapid response to competitive new product initiatives)?</td>
</tr>
<tr>
<td>Customer service defects hurt our company, but typically most consumers hold their purchase until our product is available or he/she selects another one of our products. There is limited brand switching.</td>
<td>3. Does your business have a high correlation of customer service defects to lost revenue?</td>
<td></td>
<td>If our product is not on the shelf, the consumer will (&gt;80% of time) purchase a competitive product and if delighted with it, he/she may not return to our brands. Our products have a relatively high profit margin so a lost sale is a significant hurt to our profits.</td>
</tr>
<tr>
<td>New product initiatives are &gt;80% global in design. Products are designed for global consumers. Limited regional adjustments are made to the product design (typically secondary packaging/customer requirements or local label requirements).</td>
<td>4. Are your products regionally specific? Do you typically launch regionally specific new product initiatives?</td>
<td></td>
<td>Current products and new products (formulas, primary packaging) are designed specifically for each region. There is a low level of global SC scale created from standard products, processes, and/or materials.</td>
</tr>
<tr>
<td>Technology (equipment, process, product) is highly complex or proprietary. The technology is protected legally by you and/or your suppliers.</td>
<td>5. Do you have simple technology?</td>
<td></td>
<td>Technology can be readily purchased in market. No legal technology protection is available or required.</td>
</tr>
<tr>
<td>High level of SC complexity due to unique equipment/processes, complex materials, extreme number of skus (&lt; $1,000,000 revenue/sku), and/or high sku churn (&gt;30% sku turnover per year). &gt;90% of employees need greater high school level skills.</td>
<td>6. Do you have a low level of supply chain complexity (logistics, technical)? Can you produce with available, local talent?</td>
<td></td>
<td>Low level of complexity (industry norm) and a high level of local talent is available.</td>
</tr>
<tr>
<td>SC cost is less than 15% of revenue.</td>
<td>7. Do you have a high total SC cost as a percentage of total business revenue?</td>
<td></td>
<td>SC cost is greater than 60% of revenue.</td>
</tr>
<tr>
<td>Logistics cost is less than 15% of total SC cost.</td>
<td>8. Is your Logistics cost (transportation, customs, duties, warehousing) a high percentage of your total SC (value chain) cost?</td>
<td></td>
<td>Logistics cost is greater than 65% of total SC cost.</td>
</tr>
<tr>
<td>Business prefers a low level of inventory, but will readily increase inventory to lower SC cost, mitigate revenue risk, or solve short term SC issues. Inventory/cash is not a key driver of business shareholder return.</td>
<td>9. Is Inventory Management (managing cash to the lowest levels) of high importance to your business?</td>
<td></td>
<td>Our business requires our best effort to manage inventory to the lowest possible levels. Cost and cash trade offs are analyzed thoroughly to determine the optimal decisions. Business shareholder return depends on strong cash results.</td>
</tr>
</tbody>
</table>

**How did we do?**

**30 to 45:** Supply Chain Network should be designed around local/regional manufacturing, key suppliers, warehousing, and SC technical centers.

**15 to 30:** Supply Chain network requires a more detailed TCO analysis to determine optimal network. The SC network design may be a hybrid (i.e., Mega-Regional supply).

**0 to 15:** Supply Chain Network should be designed around a few, global manufacturers, key suppliers, warehousing, and SC technical centers.
The Game-Changers Series of University of Tennessee Supply Chain Management White Papers

These University of Tennessee Supply Chain Management white papers can be downloaded by going to the “Publications” section at gsci.utk.edu.
A FINAL NOTE

We hope you have found the material in this white paper helpful and useful. We at the University of Tennessee are committed to translating our No. 1 position in academic research into information useful for practitioners. We believe the real world of industry is our laboratory. It’s why we have the largest Supply Chain Forum in the academic world, with over 50 sponsoring companies. We are always looking for industry partners to assist us in this journey. Let us know if you are interested in being one of our valued partners.

J. Paul Dittmann, Ph.D.
Executive Director, The Global Supply Chain Institute
The University of Tennessee
jdittman@utk.edu
O: 865-974-9413
C: 865-368-1836

SOURCES
This white paper is based in part on material from the recent book: Global Supply Chains: Evaluating Regions on an EPIC Framework—Economy, Politics, Infrastructure, and Competences by Mandyam Srinivasan, Theodore Stank, Philippe-Pierre Dornier, and Kenneth Petersen (McGraw-Hill Professional 2014) with permission from McGraw-Hill Professional. (See a full description of this book at the end of this document.) In addition, new research based on in-depth interviews from ten leading companies conducted in support of this white paper identifies best practices used to manage global supply chains.

GLOBAL SUPPLY CHAINS

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